DOCUMENT RESUME

ED 285 556 IR 012 762

AUTHOR Rodriguez, Stephen R.
TITLE Schema Theory and Signaling: Implications for Text Design.
PUB DATE Feb 87
NOTE 12p.; Paper presented at the Annual Convention of the Association for Educational Communications and Technology (Atlanta, GA, February 26-March 1, 1987). For the complete proceedings, see IR 012 723.
PUB TYPE Information Analyses (070) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Instructional Design; Layout (Publications); *Prompting; *Reading Comprehension; *Schemata (Cognition)
IDENTIFIERS AECT Research and Theory Division Meeting; *Computer Displays; Printed Materials; *Text Structure

ABSTRACT

This discussion of the implications of schema theory and signaling theory for the design of both paper- and computer-based text describes the macro and micro levels of text structure and their interaction, provides a definition of signaling, and identifies four types of signals: (1) pointer words informing the reader of the author's perspective on a topic; (2) prematurely revealed information previewing content presented later in the text; (3) summary statements restating major points presented in the passage; and (4) words cuing the reader to the relationships of ideas within a content structure. Research on the effects of signaling is then reviewed, and the concepts of schema induction and form schema--i.e., a schema specifying categories of information to be learned--are presented. A summary of some guidelines for computer- and paper-based text display is also provided as well as a short computer lesson designed by the author to explore possible uses of signals in computer displays. Areas for further research are suggested, and 11 references are listed. (MES)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED285556

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Title:

Schema Theory and Signaling: Implications for Text Design

Author:

Stephen Rodriguez

IR012462

BEST COPY AVAILABLE

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Michael Simonson

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Schema Theory and Signaling:

Implications for Text Design

Stephen Rodriguez
Center for Instructional Development & Services
Florida State University
2003 Apalachee Parkway
Tallahassee, FL 32301
(904) 487-2054

Introduction

Today, a great deal of instruction is delivered through text. However, text-based instruction does not always bring about desired results. Thus, we continue to search for ways to improve the instructional power of both paper and computer-based text displays.

A number of research areas offer direction for text design. The present discussion is limited to two areas of interest. First is schema theory which hypothesizes that comprehension hinges on whether a reader activates a schema coinciding with the author's. Second is signaling theory which hypothsizes that placing various aids within the text can promote comprehension.

This discussion considers implications of schema and signaling theory for text design; some relevant research is reviewed, and tentative conclusions and research questions are derived.

Macro Level of Text Structure

Text is commonly characterized as having two levels of structure -- the so-called 'macro' and 'micro' levels.

Various researchers have offered descriptions of the macro or 'top level' structure of text. The macro structure may refer to the schemata and patterns which authors employ to organize writing (Meyer, Brandt, and Bluth, 1980). Common patterns include narration, description, comparison, cause and effect, and so on. The macro level has also been described as "...the conceptual structure or organization of the passage" and as "...the outline structure" (Mayer, 1980, p.37). The macro level is "...global in nature, characterizing the discourse as a whole" (Kintsch & van Dijk, 1978, p.365).

An effective reader recognizes the author's schema and uses it to organize and later recall the ideas presented within the text:

> ...skilled readers appear to know the conventional organization patterns of text. They adapt a strategy of seeking and using the author's structure as an organizing framework for understanding and remembering the text structure (Armbruster, 1986, p.255).

Interaction of Micro and Macro Levels of Text Structure

The macro structure clarifies the topic of discourse and connects individual propositions comprising the microstructure (Kintsch and van Dijk, 1978). "The microstructure is the local level of the discourse, that is, the structure of the individual propositions and their relations" (Kintsch and van Dijk, 1978, p. 365).

The macro level structure of text specifies the logical connections among ideas and the subordination of some ideas to others (Meyer et al., 1980). Thus, we might conclude that a good reader does two things: one, grasps the author's organizational scheme, and two, employs that scheme while reading to clarify meaning and relationships among propositions. These actions, presumably, result in high comprehension.

Signaling

Signaling the macro level of text structure may provide the reader with a strategy for selecting, encoding, organizing, and later retrieving information (Meyer et al., 1980). Signaling involves the "...placement of non-content words in a passage, which serve to emphasize the conceptual structure or organization of the passage" (Mayer, 1984, p. 37). Signaling is "...information in text which does not add new content on a topic, but which gives emphasis to certain aspects of the semantic content or points out aspects of the structure content" (Meyer et al., 1980, p.77). Meyer (1975) discusses four types of signaling as follows:

1) "pointer words...explicitly inform the reader of the author's perspective of a particular idea" (p.80), e.g.-- UNFORTUNATELY, true needs assessments are rarely conducted;

2) prematurely revealed information refers to presenting a preview of content presented later in the text, e.g. -- This chapter includes discussion of simile, metaphor, personification, and alliteration;

3) summary statements restate major points presented in the passage, e.g. --

In summary, formative evaluation includes one-to-one, small-group, and field
test phases;

4) "specification of the structure of relations" (p.77) refers to wording which functions as a cue to the reader regarding the relationships of ideas within a given content structure, e.g. -- THE PROBLEM is that the shoreline erodes: THE SOLUTION is to apply soil conservation techniques.

Research on the Effects of Signaling

Some research has explored the effects of using explicit statements and underlined pointer words to signal text. Explicit signals of the structure of relationships among propositions increased the amount of information recalled on an immediate recall test (Meyer et al., 1980). The signals were conceived to have increased the saliency of the macrostructure. Unfortunately, signaling did not appear to affect recall on a retention test. (A sample of the signaled text employed in this study is presented in Appendix A.)

In a related study, text was signaled using preview sentences to state the purpose of the text and to provide an overview of the content (Loman and Mayer, 1983). Underlined headings were used to dilineate the organization of the content. Logical connectives (key words) were inserted to emphasize the cause and effect relationships among propositions. The researchers hypothesized that such signaling would encourage use of a "meaningful reading strategy" (as oppposed to rote reading strategy) and promote recall of conceptual information and subsequent problem solving. Signaling appeared to promote subjects' ability to solve problems and to recall conceptual information but not to recall verbatim information. The researchers thus see signaling as a tool for emphasizing the conceptual structure and causal links in text. By understanding the organization of the text, the reader may be better able to connect propositions and make inferences.

There would appear to be value in continued research on signaling. Loman and Mayer (1983) suggest that researchers employ dependent measures

which will reveal what -- not how much -- is learned. They urge further investigation of the characteristics of useful signals and of the effects of signals in large bodies of text.

Form Schema and Schema Induction

Brooks and Dansereau (1983) describe a form or structural schema which is said to contain information on the format of text. These authors suggest that use of a form schema can facilitate processing of "academic material." The form schema specifies categories of information that the learner is expected learn.

The researchers surveyed a variety of learners and derived a form schema for scientific theories. Some learners subsequently received training in use of a form schema as a learning aid. Those subjects completing a six hour training session on the use of the scientific theory form schema recalled more main ideas than other subjects. Also, text organized according to the form schema was shown to produce greater recall than alternatively organized text.

Organizing material consistently and emphasizing the formal components of text structure may thus help the reader to formulate and develop a new schema coinciding with the organization of the text. Such schema induction has been described by Rumelhart (1980) as the classical contiguity of learning. He proposes that "...if a certain spatio-temporal configuration of schemata is repeated, there is reason to assume that the particular configuration forms a meaningful concept and a schema can be formed that consists of just that configuration" (p. 54). Thus consistency of organization is seen as an important element in efficient text design. The idea of repeating a "spatio-temporal configuration" to form a new schema merits further investigation.

Guidelines for Computer and Paper-Based Text Displays

The question of how to design efficient computer-based text displays still remains.

Programmers and CAI developers have long known that the space within the computer display provides an essential basis for text organization. Various locations within the display are used

consistently to clarify the nature of various types of information. For instance, a title, main heading, or rule statement may appear at the top of the page. An example, illustration, or list of associated facts may appear in the middle area. Prompts are usually placed at the bottom of the screen. Similarly, when presenting questions, the core question is presented, followed by the response choices. Feedback often appears beneath the question in a consistent location. The so-called 'paging' approach to CAI programming allows for control of the spatial organization of a given display and is thus superior to the 'scrolling' technique.

Both computer and print displays can be designed and structured to emphasize schema slots. Schema slots can be emphasized and differentiated spatially within a display to promote the reader's selective perception. Further, mapping may be incorporated whereby certain spatial positions and certain standard symbols stand for relationships among the ideas within the text (Armbruster and Anderson, 1980; Gagne, 1986).

Various other text manipulations can also serve to emphasize the distinctive features of a given display and to "draw the learner's attention" to important information. Possibilties include underlining, using italics, listing, bolding, or otherwise highlighting features of the material to be selectively perceived (Gagne, 1985).

Signals in Computer Displays

No one has yet investigated how signaling techniques may be integrated in computer displays. It is unknown whether signals in computer-based lessons might have the same sorts of effects as signals in paper-based text.

In an attempt to explore possible uses of signals in computer displays, this author developed a short computer lesson on the workings of an electric bell. The lesson begins with an brief explanation of the organization of the information within the lesson (i.e., the purposes of the signals employed are explained). The lesson then presents one proposition at a time. The elements within each proposition are signaled to indicate the relationships among the presented words. The subject of each proposition is labeled as PART; the requisite action necessary for the

identified PART to function is labeled ACTION; and the consequence of the PART functioning is labeled RESULT. Each component was further differentiated in space. (See Appendix B for samples of the signaled computer-text displays.)

It was conceived that the signals would emphasize the key components of the propositions, clarify the relationships among components of each proposition, and promote recollection of the explained information. Results of a pilot test show a trend in this direction.

The idea of signaling elements of propositions may merit further consideration. Such an approach might be useful in language and grammar instruction or when the instructional content can be structured consistently and is suitable for a "proposition by proposition" presentation.

Conclusion

Much work is yet to be done if we are to clarify possible relationships among schemata, comprehension, text organization, and text enhancements such as signaling. Given the overwhelming amount of text-based instruction and our progress to this point, issues of text design surely merit further exploration.

References

Armbruster, B. B. (1986). Schema theory and the design of content-area textbooks. Educational Psychologist, 21(4), 253-267.

Armbruster, B. B., & Anderson, T. H. (1980). Effects of mapping on the free recall of expository text. Urbana, IL: Center for the Study of Reading (Tech. Rep. No. 160).

Brooks, L. W., & Dansereau, D. F. (1983). Effects of structural schema training and text organization on expository prose processing. Journal of Educational Psychology, 78(6), 811-820.

Gagné, R. M. (1985). The conditions of learning (4th ed.). New York: Holt, Rinehart and Winston.

Gagne, R. M. (1986). Instructional technology: The research field. Journal of Instructional Development, 8(3), 7-14.

Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. Psychological Review, 85(7), 363-393.

Loman, N. L., & Mayer, R. E. (1983). Signaling techniques that increase the understandability of expository prose. Journal of Educational Psychology, 75(3), 402-412.

Mayer, R. E. (1984). Aids to text comprehension. Educational Psychologist, 19(1), 30-42.

Meyer, B. J. F. (1975). The organization of prose and its effects on memory. New York: American Elsevier.

Meyer, B. J. F., Brandt, D. M., & Bluth, G. J. (1980). Use of top-level structure in text: Key for reading comprehension of ninth graders. Reading Research Quarterly, 16(1), 72-103.

Rumelhart, D. E. (1980). Schemata: the building blocks of cognition. In R. J. Spiro, B. C. Bruce, & G. W. F. Brewer (Eds.), Theoretical issues in reading comprehension (pp. 33-58). Hillsdale, NJ: Erlbaum Associates.

Appendix A

Supertankers

A PROBLEM OF VITAL CONCERN IS THE PREVENTION OF OIL SPILLS FROM SUPERTANKERS. A typical supertanker carries a half-million tons of oil and is the size of five football fields. A wrecked supertanker spills oil in the ocean; this oil kills animals, birds, and microscopic plant life. *For example, when a tanker* crashed *off the coast of England, more than 200,000 dead seabirds* washed *ashore.* Oil spills also kill microscopic plant life *which provide food for sea life and produce 70 percent of the world's oxygen supply.* Most wrecks RESULT FROM THE LACK of power and steering equipment to handle emergency situations, *such as storms. Supertankers have only one boiler to provide power and one propeller to drive the ship.*

THE SOLUTION TO THE PROBLEM IS NOT TO IMMEDIATELY HALT THE USE OF TANKERS ON THE OCEAN since about 80 percent of the world's oil supply is carried by supertankers. INSTEAD, THE SOLUTION LIES IN THE TRAINING OF OFFICERS OF SUPERTANKERS, BETTER BUILDING OF TANKERS, AND INSTALLING GROUND CONTROL STATIONS TO GUIDE TANKERS NEAR SHORE. First, OFFICERS OF SUPERTANKERS MUST GET top TRAINING in how to run and maneuver their ships. Second, tankers should be BUILT with several propellers *for extra control* and backup boilers *for emergency power.* Third, GROUND CONTROL STATIONS SHOULD BE INSTALLED at places where supertankers come close to shore. These stations would act like airplane control towers, guiding *tankers along busy shipping lanes and through dangerous channels.*

Signaled text used in study by Meyer et al., 1980

BEST COPY AVAILABLE

Appendix B

|10

PART: Electromagnet

ACTION: is energized;

RESULT: electromagnet attracts hammer arm.

85
S: → =CONTINUE, ← =REVIEW, I=INDEX,, D=

|12

PART: Interrupter contact on hammer arm

ACTION: opens;

RESULTS: circuit is broken;

electromagnet is de-energized;

hammer arm is released.

86
INUE, ← =RREVIEW, I=INDEX, D=DETAILS...

|14

PART: Hammer arm

ACTION: moves back;

RESULT: interrupter contact closes

Signaled computer displays on the workings of an electric bell.